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Physician-Endorsed vs Autonomous Updated COVID-19 Vaccine Willingness Among High-Risk Individuals: A Scenario-Based Study in Türkiye

Volkan Atasoy

volkanatasoy@trabzon.edu.tr

Trabzon University Faculty of Medicine

Ceyhun Yurtsever

Kanuni Training and Research Hospital, Family Medicine Clinic

Mehmet Vatansever

Trabzon University Faculty of Medicine

Pınar Küçük

Kanuni Training and Research Hospital, Family Medicine Clinic

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Abstract

Background

Updated COVID-19 vaccines targeting circulating variants are recommended for individuals at high risk of severe disease. However, in Türkiye, these vaccines are not currently available. Understanding how high-risk individuals respond to hypothetical vaccine availability, and how their intentions vary across decision contexts, is important for informing future vaccination strategies.

Methods

This cross-sectional study with a within-participant, scenario-based comparison was conducted in a tertiary care hospital between January and June 2025. Adults aged ≥ 18 years with at least one high-risk condition for severe COVID-19 were included. Participants completed a structured questionnaire assessing baseline willingness to receive an updated COVID-19 vaccine under a hypothetical availability scenario. Following standardized counseling, they were asked whether they would accept vaccination if recommended by their physician. Paired responses were compared using the McNemar test.

Results

A total of 406 participants (median age 69 years, 72.4% male) were included. At baseline, 152 participants (37.4%) reported willingness to receive the updated vaccine. Under a physician-recommended scenario, 265 participants (66.3%) expressed willingness. Among those initially unwilling, 120 (47.2%) indicated they would accept vaccination if recommended by their physician, corresponding to a number needed to counsel of 2.1. This within-participant shift was statistically significant (McNemar test, $p < 0.001$). The most commonly reported barriers were concerns about side effects (37.9%) and lack of confidence in the vaccine (15.0%).

Conclusions

Willingness to receive updated COVID-19 vaccines among high-risk individuals in Türkiye is limited under autonomous decision conditions but substantially higher in a physician-endorsed context. These findings suggest that vaccination intentions are highly sensitive to decision context and highlight the potential role of physician engagement in improving vaccine uptake if access barriers are addressed.

1. Introduction

Since the declaration of the World Health Organization COVID-19 pandemic in March 2020, the global health landscape has undergone a profound transformation [1]. Although the acute phase of the pandemic has subsided, COVID-19 continues to pose a substantial burden, particularly among

individuals at high risk of severe disease. As of late 2025, hundreds of millions of confirmed cases and millions of deaths have been reported worldwide, and seasonal resurgences continue to contribute to excess morbidity and mortality [2]. The emergence and global dominance of novel SARS-CoV-2 lineages, such as JN.1, further highlight the ongoing evolutionary dynamics of the virus and the need for adaptive preventive strategies [3].

In response to these developments, international health authorities recommend updated COVID-19 vaccines targeting currently circulating variants, particularly for high-risk populations such as older adults, individuals with chronic diseases, immunocompromised patients, and those with multiple comorbidities [4, 5]. These updated vaccines have been widely implemented in many high-income countries since 2023 and have demonstrated effectiveness in reducing severe outcomes [6]. Despite these recommendations, uptake of updated COVID-19 vaccines remains suboptimal. Even in settings where vaccines are readily available, a considerable proportion of eligible individuals do not receive them [7]. This gap has been largely attributed to vaccine hesitancy, driven by concerns about safety, perceived reduced disease severity, and declining risk perception in the post-pandemic context [8]. Importantly, vaccine decision-making is not solely determined by individual beliefs but is strongly influenced by contextual and interpersonal factors, among which physician recommendation consistently emerges as one of the most powerful determinants of vaccine acceptance [9].

However, the situation in Türkiye presents a distinct and underexplored public health context. While international guidelines recommend updated COVID-19 vaccination for high-risk individuals, these vaccines have not been made available in the country [10]. This creates a unique “access paradox”: individuals who are most likely to benefit from vaccination are unable to access it, and their acceptance of such vaccines cannot be observed in real-world conditions. As a result, existing evidence from countries with vaccine availability may not be directly generalizable to this setting. Understanding how high-risk individuals in Türkiye would respond to updated vaccines if they were available is therefore critical for informing future procurement policies and implementation strategies.

Beyond simple measures of willingness, it is particularly important to distinguish between autonomous vaccination intention and intention under physician endorsement. While individuals may initially express reluctance, their decisions may shift substantially when recommendations are provided by a trusted healthcare professional [11]. Evaluating this distinction offers insight into the potential impact of provider-based interventions and helps identify modifiable levers for improving vaccine uptake once access barriers are resolved.

In this context, the present study aimed to assess (i) the baseline willingness of high-risk individuals in Türkiye to receive an updated COVID-19 vaccine under a hypothetical availability scenario, (ii) the reasons underlying their willingness or unwillingness, and (iii) the extent to which willingness differs under a physician-recommended scenario following structured counseling. Rather than assuming a direct causal effect of counseling, this study compares vaccination intentions across different decision

contexts to understand how physician endorsement may shape vaccine acceptance in a setting with limited access.

2. Methods

2.1. Study Design and Setting

This study was designed as a cross-sectional survey with a within-participant, scenario-based comparison. Data were collected at the family medicine outpatient clinic and the adult vaccination outpatient clinic of a tertiary care hospital in Trabzon, Türkiye, between January 1 and June 30, 2025. Rather than evaluating the causal effect of an intervention, the study aimed to compare vaccination intentions under two distinct decision contexts within the same individuals: (i) autonomous intention in a hypothetical vaccine availability scenario, and (ii) intention under a physician-endorsed scenario following structured counseling.

2.2. Participants and Eligibility Criteria

Eligible participants were adults aged ≥ 18 years with at least one condition associated with increased risk of severe COVID-19, as defined by international guidelines. These conditions included age ≥ 65 years, diabetes mellitus, chronic lung disease, chronic heart disease, chronic kidney disease, chronic liver disease, active cancer treatment, immunosuppression, organ or hematopoietic stem cell transplantation, pregnancy, or the presence of multiple comorbidities. Individuals were excluded if they were unable to complete the questionnaire due to cognitive impairment or language barriers.

2.3. Sampling and Recruitment

Participants were recruited consecutively among individuals presenting to the outpatient clinics during the study period. Of 487 eligible individuals, 406 agreed to participate (response rate: 83.4%) and completed all study procedures. No sampling frame or randomization was applied.

2.4. Data Collection and Measures

Data were collected through face-to-face interviews using a structured questionnaire developed for this study by the research team, based on existing literature on vaccine hesitancy and clinical experience in adult vaccination (provided as Supplementary File 1). The questionnaire consisted of three sections:

Section 1 collected sociodemographic characteristics including age, sex, education level, income level, employment status, living arrangement, and smoking status.

Section 2 assessed clinical characteristics including type of high-risk condition(s), intensive care unit admission, and loss of a relative due to COVID-19. Prior COVID-19 infection, hospitalization, and vaccination status were also recorded.

Section 3 evaluated attitudes toward the updated COVID-19 vaccine. Participants were first informed that the updated monovalent vaccine recommended by WHO is not available in Türkiye. They were then asked: (a) whether they would like the vaccine to be available in Türkiye, (b) whether they would get vaccinated if the vaccine were available (baseline willingness), and (c) reasons for their willingness or unwillingness (using predefined categories with free-text "other" option).

2.5. Counseling Procedure and Scenario Framing

Following completion of the baseline questionnaire, all participants received standardized vaccination counseling delivered by physicians in the adult vaccination clinic. The counseling included information on the indications, effectiveness, safety profile, and potential side effects of updated COVID-19 vaccines, in accordance with international recommendations. After counseling, participants were asked whether they would accept vaccination if it were recommended by their physician. Importantly, due to the unavailability of updated COVID-19 vaccines in Türkiye, both baseline and post-counseling responses were based on hypothetical scenarios. The two questions differed not only in timing but also in decision context, autonomous versus physician-endorsed, allowing comparison of intention under different informational and relational conditions rather than measurement of a pure intervention effect.

2.6. Outcomes

The primary outcome was baseline willingness to receive an updated COVID-19 vaccine under a hypothetical availability scenario. The secondary outcome was willingness under a physician-recommended scenario following counseling. A secondary analytical focus was the change in willingness between these two scenarios among individuals initially unwilling to be vaccinated.

2.7. Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 23.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality and are presented as median with interquartile range (IQR). Categorical variables are presented as frequencies and percentages. Comparisons between participants willing and unwilling to receive the vaccine at baseline were conducted using the Mann–Whitney U test for continuous variables and the chi-square test or Fisher’s exact test for categorical variables, as appropriate. To evaluate within-participant differences in willingness between baseline and physician-recommended scenarios, the McNemar test for paired categorical data was used. Multivariable logistic regression analyses were performed to identify factors associated with (i) baseline unwillingness and (ii) change in willingness among initially unwilling participants. Variables were selected based on clinical relevance and prior literature. Results are presented as odds ratios (ORs) with 95% confidence intervals (CIs). A two-sided p-value < 0.05 was considered statistically significant.

3. Results

3.1. Participant characteristics

A total of 406 high-risk individuals were included in the study. The median age was 69 years (IQR: 8), and 72.4% were male. The majority of participants had low educational attainment (68.7%), low income (65.5%), and were not working (95.3%). Participant characteristics, including high-risk conditions and COVID-19 history, are shown in Table 1.

Table 1
Participant characteristics (n = 406)

Variable	Total (n = 406)
Sociodemographic characteristics	
Age	69 [8]
Male sex	294 (72.4)
Education ≤ primary school	279 (68.7)
Low income	266 (65.5)
Not working	387 (95.3)
Living with high-risk person	272 (67.0)
Never smoked	232 (57.1)
High-risk conditions	
Number of risk conditions	2 [1]
Age ≥ 65 years	369 (90.9)
Diabetes mellitus	126 (31.0)
Chronic heart disease	116 (28.6)
Chronic lung disease	64 (15.8)
Chronic kidney disease	22 (5.4)
Multiple comorbidities	9 (2.2)
Active cancer treatment	5 (1.2)
Immunosuppression	3 (0.7)
Chronic liver disease	2 (0.5)
COVID-19 history	
Prior COVID-19 infection	162 (39.9)
Prior COVID-19 hospitalization	23 (5.7)
ICU admission	5 (1.2)
Data are presented as n (%) or median [IQR].	
Participants could select multiple conditions.	
ICU: intensive care unit.	

Variable	Total (n = 406)
Sociodemographic characteristics	
Lost relative due to COVID-19	105 (25.9)
Prior COVID-19 vaccination	397 (97.8)
Data are presented as n (%) or median [IQR].	
Participants could select multiple conditions.	
ICU: intensive care unit.	

3.2. Awareness and general attitudes toward the updated vaccine

Only 22 participants (5.4%) were aware that the updated COVID-19 vaccine was not available in Türkiye. Nevertheless, 184 participants (45.3%) stated that they would like the vaccine to be available. At baseline, 152 participants (37.4%) reported that they would be willing to receive the updated COVID-19 vaccine if it were available. When asked whether they would accept vaccination if recommended by their physician, 265 participants (66.3%) responded positively.

3.3. Reasons for willingness and unwillingness

Reasons for willingness and unwillingness to receive the updated COVID-19 vaccine are shown in Table 2.

Table 2
Reasons for willingness and unwillingness to receive the updated COVID-19 vaccine

Reason	n (% of total sample, n = 406)
Willingness reasons (baseline)	
Not wanting to get sick	88 (21.7)
Being in a risk group	48 (11.8)
Physician recommendation	52 (12.8)
Community health importance	17 (4.2)
Free vaccine	7 (1.7)
Unwillingness reasons (baseline)	
Concerns about side effects	154 (37.9)
Lack of confidence in vaccine efficacy	61 (15.0)
Concerns about vaccine content	61 (15.0)
Commercial concerns	4 (1.0)
Preference for natural immunity	3 (0.7)
Data are presented as n (%). Participants could select multiple reasons.	

3.4. Change in willingness following counseling and physician recommendation

A paired comparison of responses showed a significant shift in willingness under the post-counseling physician recommendation scenario. Among the 254 participants who were unwilling at baseline, 120 (47.2%) reported that they would accept vaccination if recommended by their physician. Among the 152 participants who were initially willing, 145 (95.4%) remained willing, while 7 (4.6%) reported a change to unwillingness. Overall, the number of participants willing to receive the vaccine increased from 152 (37.4%) to 265 (66.3%). This shift in responses was statistically significant (McNemar test: $\chi^2 = 98.8$, $p < 0.001$). The McNemar test was driven by a pronounced imbalance in discordant pairs (120 vs 7), reflecting a directional shift toward increased willingness. Among initially unwilling participants, 47.2% (120/254) changed to willingness under the physician-recommended scenario. This corresponds to an approximate number needed to counsel (NNC) of 2.1 initially unwilling individuals for one additional positive vaccination intention.

3.5. Factors associated with baseline unwillingness

In the multivariable logistic regression analysis, none of the examined sociodemographic or clinical variables were significantly associated with baseline unwillingness to receive the updated COVID-19

vaccine (Table 3). Although not statistically significant, never smoking status showed a tendency toward lower odds of unwillingness (OR: 0.72, 95% CI: 0.46–1.12, p = 0.147), and age ≥ 65 years showed a tendency toward higher odds of unwillingness (OR: 1.66, 95% CI: 0.76–3.63, p = 0.203).

Table 3
Factors associated with baseline unwillingness to receive the updated COVID-19 vaccine (n = 406)

Variable	OR (95% CI)	p-value
Male sex	1.05 (0.62–1.77)	0.870
≥High school education	0.95 (0.56–1.59)	0.831
Low income	0.77 (0.47–1.27)	0.307
Living with a high-risk individual	0.98 (0.63–1.54)	0.943
Never smoker	0.72 (0.46–1.12)	0.147
Age ≥ 65 years	1.66 (0.76–3.63)	0.203
Number of comorbidities	1.16 (0.91–1.49)	0.229
Prior COVID-19 infection	0.88 (0.58–1.35)	0.558
Prior COVID-19 vaccination	0.43 (0.11–1.67)	0.223
OR: odds ratio, CI: confidence interval. Multivariable logistic regression model.		

3.6. Factors associated with change in willingness among initially unwilling participants

Among initially unwilling participants, age ≥ 65 years (OR: 2.54, 95% CI: 1.01–6.42) and a higher number of comorbidities (OR: 1.53, 95% CI: 1.09–2.15) were significantly associated with a change in willingness (Table 4).

Table 4
Factors associated with change in willingness among initially unwilling participants (n = 254)

Variable	OR (95% CI)	p-value
Male sex	1.19 (0.62–2.27)	0.603
≥High school education	1.99 (0.91–4.35)	0.083
Low income	1.87 (0.88–3.98)	0.104
Living with a high-risk individual	1.66 (0.94–2.93)	0.078
Never smoker	1.35 (0.75–2.41)	0.315
Age ≥ 65 years	2.54 (1.01–6.42)	0.049
Number of comorbidities	1.53 (1.09–2.15)	0.015
Prior COVID-19 infection	0.70 (0.41–1.19)	0.187
Prior COVID-19 vaccination	0.32 (0.03–3.42)	0.348
OR: odds ratio, CI: confidence interval. Multivariable logistic regression model.		

4. Discussion

This study provides insight into how high-risk individuals in Türkiye respond to the idea of updated COVID-19 vaccination in a context where such vaccines are recommended internationally but not currently available. The findings highlight a clear discrepancy between autonomous vaccination intention and intention expressed under a physician-endorsed scenario, suggesting that decision context plays a critical role in shaping vaccine acceptance.

4.1. Low Autonomous Willingness in a Post-Pandemic Context

At baseline, only a minority of participants reported willingness to receive an updated COVID-19 vaccine. This is notable given that the study population consisted predominantly of older adults with multiple comorbidities and a very high rate of prior COVID-19 vaccination. The observed reluctance therefore does not reflect general opposition to vaccination but rather a context-specific hesitancy toward updated vaccines in the post-pandemic phase. This finding is consistent with accumulating evidence that perceived disease severity and personal risk have declined over time, even among high-risk groups [12–14]. As the acute phase of the pandemic has receded, vaccination decisions appear to be increasingly influenced by perceived necessity rather than prior adherence to vaccination programs. The relatively low baseline willingness observed in this study aligns with global reports of reduced booster uptake [15], although the magnitude of reluctance in this cohort appears higher than that reported in many settings

[16]. This may reflect the unique informational and policy environment in Türkiye, where the absence of updated vaccines may contribute to reduced perceived relevance and increased uncertainty.

4.2. The Role of Concerns and Information Gaps

The primary barriers identified, concerns about side effects, lack of confidence, and uncertainty about vaccine content, are consistent with the global literature on vaccine hesitancy, where safety concerns consistently rank as the primary reason for vaccine refusal [17–19]. Importantly, ideological opposition to vaccination was rare, suggesting that most hesitant individuals in this cohort are potentially responsive to targeted information and reassurance. The prominence of concerns related to vaccine content and safety may indicate exposure to inconsistent or unreliable information, particularly in populations with lower socioeconomic and educational status [20]. In such contexts, the absence of an actively implemented vaccination program may further limit opportunities for structured, evidence-based communication. These findings underscore the importance of addressing specific concerns through transparent and accessible communication strategies rather than relying solely on general pro-vaccination messaging.

4.3. Physician-Endorsed Scenario and Decision Context Shift

A key finding of this study is the substantial increase in reported willingness under a physician-recommended scenario. Nearly half of the participants who were initially unwilling indicated that they would accept vaccination if recommended by their physician, resulting in a marked overall increase in willingness. This difference should not be interpreted as a direct causal effect of counseling alone. Rather, it reflects a shift in decision context, from an autonomous, hypothetical decision to one framed within a trusted patient–physician relationship. In line with previous research, physician recommendation appears to function as a critical mediator of vaccine decision-making, particularly in populations facing uncertainty or information asymmetry. Physicians are consistently ranked as the most trusted source of vaccine information, particularly for older adults and those with chronic diseases [21]. Individuals who receive a physician recommendation are significantly more likely to accept vaccination, and provider recommendation is among the most effective interventions to increase vaccine uptake across populations [22].

From a behavioral perspective, this shift may be explained by mechanisms such as trust, perceived expertise, and reduction of decisional uncertainty. Individuals who are hesitant in abstract or hypothetical scenarios may rely more heavily on physician guidance when faced with concrete recommendations. This corresponds to a NNC of 2.1, meaning that for every two initially unwilling individuals who receive physician counseling, one additional person would express willingness to be vaccinated. This highlights the potential practical impact of physician engagement, while acknowledging that this estimate reflects a change in decision context rather than a pure intervention effect. The magnitude of change observed in this study suggests that physician endorsement represents a highly modifiable lever for influencing vaccine acceptance once access barriers are removed. From a practical

standpoint, our finding suggests that targeting counseling efforts toward older adults with multiple chronic conditions could be a particularly efficient strategy. Clinicians should be aware that although these individuals may appear more hesitant at baseline, they are also more likely to benefit from physician-led counseling.

4.4. Absence of Strong Sociodemographic Predictors

In contrast to earlier phases of the pandemic, no sociodemographic or clinical variables were significantly associated with baseline unwillingness. Unlike earlier pandemic phases where younger age and lower education predicted hesitancy [23, 24], our null finding suggests that unwillingness is broadly distributed across high-risk individuals rather than concentrated within specific subgroups. This is consistent with systematic review evidence that demographic factors show inconsistent results across studies and are not explanatory variables but carriers for underlying beliefs and attitudes [15]. The relatively homogeneous nature of the study population, characterized by older age, low educational attainment, and high comorbidity burden, may have limited variability and reduced the ability to detect associations. An association between age or marital status and booster acceptance has been reported elsewhere [14], while global acceptance rates vary significantly across regions [25]. These findings are consistent with literature suggesting that demographic variables alone are insufficient to explain vaccine hesitancy and that attitudes, beliefs, and contextual factors play a more central role.

4.5. The Access Paradox: Demand Without Availability

One of the most important implications of this study is the identification of an “access paradox.” A substantial proportion of participants expressed willingness to receive updated COVID-19 vaccines under certain conditions, yet such vaccines are not currently available in Türkiye. This creates a situation in which both willing and potentially persuadable individuals remain unprotected, not due to refusal but due to structural barriers. Moreover, the inability to access vaccines may itself reinforce hesitancy by reducing perceived urgency and limiting exposure to consistent public health messaging. In this sense, access and acceptance should not be viewed as independent phenomena but as interrelated components of vaccine uptake. Addressing supply constraints may therefore have downstream effects on demand, particularly when combined with physician-led communication strategies.

4.6. Strengths and Limitations

This study has several strengths. It examines vaccination attitudes in a unique policy context where updated vaccines are recommended but not available, providing insight that is not easily captured in settings with established vaccination programs. The within-participant comparison allows evaluation of how intentions vary across decision contexts, reducing between-subject variability. However, several limitations should be considered. First, all responses were based on hypothetical scenarios, and stated intentions may not directly translate into actual vaccination behavior. Second, the study was conducted in a single tertiary care center with a predominantly older and socioeconomically homogeneous population, which may limit generalizability. Third, the comparison between baseline and post-counseling responses reflects differences in both informational exposure and question framing, and

therefore should not be interpreted as a pure intervention effect. Finally, the absence of a control group precludes causal inference regarding the effect of counseling.

4.7. Implications for Practice and Policy

The findings of this study have several implications. First, there appears to be a measurable level of latent demand for updated COVID-19 vaccines among high-risk individuals in Türkiye. Ensuring access to these vaccines is therefore essential to align national practice with international recommendations. Second, physician engagement is likely to play a pivotal role in translating potential willingness into actual uptake. The marked difference between autonomous and physician-endorsed scenarios suggests that provider-based communication strategies could substantially improve vaccination coverage once vaccines become available. Finally, public health interventions should focus on addressing specific concerns related to safety and vaccine content, particularly in populations with limited access to reliable information. Integrating physician recommendation with broader communication efforts may offer a synergistic approach to improving vaccine acceptance.

5. Conclusions

Only one-third of high-risk individuals in this Turkish study would accept an updated COVID-19 vaccine on their own. However, willingness under physician-endorsed scenario is substantially higher than autonomous intention. These findings have several important implications:

Vaccine access: Availability and accessibility of updated COVID-19 vaccines for high-risk groups is critical to align with international recommendations. The current situation where international guidelines recommend vaccination for high-risk individuals but no updated vaccine is accessible represents a significant gap in preventive health services.

Physician empowerment: Physicians should be equipped with accurate information about updated vaccines and encouraged to provide evidence-based recommendations. The NNC for one additional positive vaccination intention was 2.1 among initially unwilling individuals, indicating high practical utility of physician recommendation. Prioritizing older adults with multiple comorbidities in vaccine counseling may yield the greatest benefits.

Risk communication: Public health campaigns may benefit from addressing specific concerns (side effects, vaccine content) through trusted messengers, including physicians. The observation that "not wanting to get sick" was the top motivator suggests that emphasizing personal protection could be an effective strategy.

The present study provides empirical evidence that there is measurable demand for updated COVID-19 vaccines among high-risk individuals in Türkiye and that physician recommendation can significantly increase acceptance.

Abbreviations

NNC
Number needed to counsel
IQR
Interquartile range
OR
Odds ratio
CIs
Confidence intervals

Declarations

Ethics approval and consent to participate

The study protocol was approved by the Scientific Research Ethics Committee of Trabzon Faculty of Medicine (approval number: 2024/157). All participants provided written informed consent. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable. This manuscript does not contain any individual person's data in any form.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

V.A.: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing; C.Y.: Investigation, Resources, Writing – review & editing; M.V.: Supervision, Resources, Writing – review & editing; P.K.: Supervision, Resources, Writing – review & editing. All authors read and approved the final manuscript

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. World Health Organization. COVID-19 epidemiological update – 16 February 2024. Geneva: WHO; 2024.
2. World Health Organization. WHO Coronavirus (COVID-19) Dashboard. Available from: https://covid19.who.int/. Accessed 14 Apr 2026.
3. Lei ZY, Jin QT, Zhang XM, Bo XC, Ren ZL, Tong YG, Ni M. Genomic-epidemiological analysis of 15 million SARS-CoV-2 genomes reveals accelerated fitness gain of JN.1 lineage. Virol Sin. 2026 Apr;8. 10.1016/j.virs.2026.03.015.
4. World Health Organization. SAGE updated COVID-19 vaccination guidance. Geneva: WHO; 2023.
5. Centers for Disease Control and Prevention. COVID-19 vaccination for people who are moderately or severely immunocompromised. Atlanta: CDC; 2024.
6. Breznik JA, Miller MS, Bowdish DME. Rationalizing recommendations for influenza and COVID-19 vaccines. Vaccine. 2025;65:127775. doi.org/10.1016/j.vaccine.2025.127775.
7. Centers for Disease Control and Prevention. COVID-19 Vaccination Coverage and Intent Among Adults. Updated February 2025. Available from: https://www.cdc.gov/covidvaxview/weekly-dashboard/adult-vaccination-coverage.html Accessed 20 Apr 2026.
8. Fedele F, Aria M, Esposito V, Fabbrocini G, Ferrara P, Griffiths P, et al. Determinants of COVID-19 vaccine hesitancy: a cross-sectional study in Italy. Public Health. 2023;218:45–52. doi.org/10.1016/j.puhe.2023.02.015.
9. Nguyen T, Henningsen KH, Brehaut JC, Hoe E, Wilson K. The role of physician recommendation in COVID-19 vaccine uptake. Public Health. 2021;197:112–8. doi.org/10.1016/j.puhe.2021.06.010.
10. KLİMİK (Turkish Society of Clinical Microbiology and Infectious Diseases). Position paper: Where do we stand as we enter the fifth year of the COVID-19 pandemic? What should we do? Istanbul: KLİMİK; 11 March 2024.
11. Lasagna A, Alessio N, Gambini G, Klersy C, Monaco T, Corallo S, et al. Vaccine hesitancy in patients with solid tumors: a cross-sectional single-center survey. BMC Public Health. 2024;24(1):2998. 10.1186/s12889-024-20468-y.

12. Wang J, Zhang Y, Long R, Chen H, Chen Y. COVID-19 vaccine acceptance among older adults: a cross-sectional study in China. Public Health. 2022;203:15–22. doi.org/10.1016/j.puhe.2021.12.008.
13. Kitro A, Sirikul W, Polpitakchai C, Panumasvivat J, Yamsiri R, Tasena P, et al. Post-pandemic perspectives: willingness, risk perception and factors influencing COVID-19 booster vaccine uptake among Thai healthcare workers and vulnerable populations. Vaccines. 2024;12(12):1381. doi.org/10.3390/vaccines12121381.
14. Songthap A, Sesang K, Ratchaphan C, Luangkhan T, Jenjob P. Factors influencing the third COVID-19 vaccine booster dose acceptance among older adults in northern Thailand. BMC Infect Dis. 2024;24(1):897. doi.org/10.1186/s12879-024-09785-0.
15. Limbu YB, Huhmann BA. Why some people are hesitant to receive COVID-19 boosters: a systematic review. Trop Med Infect Dis. 2023;8(3):159. doi.org/10.3390/tropicalmed8030159.
16. Veronese N, Saccaro C, Demurtas J, Smith L, Dominguez LJ, Barbagallo M, et al. Global COVID-19 vaccine hesitancy among elderly: A systematic review. Vaccine: X. 2024;21:100584. doi.org/10.1016/j.jvacx.2024.100584.
17. Roy DN, Biswas M, Islam E, Azam MS. Potential factors influencing COVID-19 vaccine acceptance and hesitancy: a systematic review. PLoS ONE. 2022;17(3):e0265496. doi.org/10.1371/journal.pone.0265496.
18. Troiano G, Nardi A. Vaccine hesitancy in the era of COVID-19. Public Health. 2021;194:245–51. doi.org/10.1016/j.puhe.2021.02.025.
19. Sallam M. COVID-19 vaccine hesitancy worldwide: a systematic review of vaccine acceptance rates. Vaccines. 2021;9(8):898. doi.org/10.3390/vaccines9080898.
20. Soares P, Rocha JV, Moniz M, Gama A, Laires PA, Pedro AR, et al. Safety concerns and COVID-19 vaccine acceptance: a multinational study. Public Health. 2022;205:89–96. doi.org/10.1016/j.puhe.2022.01.020.
21. Paterson P, Meurice F, Stanberry LR, Glismann S, Rosenthal SL, Larson HJ. Vaccine hesitancy and healthcare providers. Vaccine. 2016;34(52):6700–6. doi.org/10.1016/j.vaccine.2016.10.042.
22. Brewer NT, Chapman GB, Rothman AJ, Leask J, Kempe A. Increasing vaccination: a review. Am J Prev Med. 2017;52(5):857–65. doi.org/10.1016/j.amepre.2016.12.004.
23. Razai MS, Osama T, McKechnie DGJ, Majeed A. COVID-19 vaccine hesitancy. BMJ. 2021;373:n1138. doi.org/10.1136/bmj.n1138.
24. Dror AA, Eisenbach N, Taiber S, Morozov NG, Mizrachi M, Zigron A, et al. Vaccine hesitancy in Israel. Eur J Epidemiol. 2020;35(8):775–9. doi.org/10.1007/s10654-020-00663-8.
25. Abdelmoneim SA, Sallam M, Hafez DM, Elrewany E, Mousli HM, Hammad EM, et al. COVID-19 vaccine booster dose acceptance: systematic review and meta-analysis. Trop Med Infect Dis. 2022;7(10):298. doi.org/10.3390/tropicalmed7100298.

Supplementary Files

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